UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/582,330	06/09/2006	Hitoshi Sumiya	070456-0115	4934

20277 7590 07/15/2010

MCDERMOTT WILL & EMERY LLP
600 13TH STREET, N.W.
WASHINGTON, DC 20005-3096

EXAMINER	
HAN, SHENG	

ART UNIT	PAPER NUMBER
1793	

MAIL DATE	DELIVERY MODE
07/15/2010	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/582,330	SUMIYA, HITOSHI	
	Examiner	Art Unit	
	SHENG HAN	1793	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5 and 12-16* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5, 12-16* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 1, 2, 3 are rejected under 35 U.S.C. 103(a) as being unpatentable over Meng (2003/0039603) and further in view of Swain.

Meng teaches a method for synthesizing boron doped diamond for improving the oxidation resistance of said diamond crystals includes forming a fully dense core (mixture) of graphite, catalyst/solvent metals, optional diamond seed crystals, and a source of boron (abstract). This mixture is subjected to diamond-formed high pressure/high temperature (HP/HT) conditions for a time adequate for forming diamond. The thus-formed diamond product is recovered to contain boron substituted into the diamond structure (abstract). The fully dense core is substantially devoid of nitrogen (N) content, which mostly comes from air (abstract). Thus, the fully dense core is substantially devoid of air. The preferred source of B is amorphous B; although other sources of B can be used to form the boron-doped, blue diamond of the present invention (abstract).

Meng describes this method for producing boron doped diamond that includes forming a fully dense core (mixture) of graphite, catalyst/solvent sintering aid, an optional diamond seed crystals, and a source of boron (para. 0009). This mixture is subjected to diamond-formed high pressure/high temperature (HP/HT) conditions for a

time adequate for forming diamond (para. 0009). The thus-formed diamond product is recovered to contain boron substituted into the diamond structure. The fully dense core is substantially devoid of nitrogen (N) content, which mostly comes from air. Thus, the fully dense core is substantially devoid of air (para. 0009). The preferred source of 13 is amorphous B; although other sources of B can be used to form the boron-doped, blue diamond of the present invention (para. 0009).

The boron itself is substituted into the diamond structure (para. 0009 and 0014). The amount of boron used can be between 0.001 to 0.6% (para. 0016).

Although Meng teaches these features, Meng does not disclose that the size of the diamond averages at about 50nm and is at most 100nm.

Swain teaches a boron-doped nanocrystalline diamond (title, abstract). The diamond particles are disclosed to be between 10-16nm in size (para. 43) or 20nm (para. 0031) and the boron concentration is between 1 to 20ppm (para. 0034 and 0071). The elemental boron is in the crystal as a dopant (para. 0011, 0012). This boron is incorporated within the lattice of diamond lattice (para. 0071). The diamond nanocrystals are highly conductive (para. 0031(i)). Although Swain does not specifically teach that the average particle size is below 50nm, however, it is inherent that since the particle range is all below 50nm, that the average particle size would be below 50nm.

It would have been obvious to one of ordinary skill in the art at the time of the invention that the size of the diamond particles could be optimized based on the desired use, accuracy of the diamond and the size of the device it would be used with. Furthermore, it would be obvious to one of ordinary skill in the art at the time of the

invention that the selection of a specific size range is viewed to be the optimization of a known process, which could have been determined through routine experimentation, and is held to be obvious by *In re Boesch,* 205 USPQ 215.

Regarding Claim 2, Swain teaches an electrical resistance of 0.2 ohm cm (para. 0031). This is less than 10 ohm cm.

Regarding Claim 3, since Swain teaches a particle range of between 10-16nm (para. 0034), the maximum particle range is less than 50nm and the average particle diameter is less than 30nm.

Claims 4 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Meng in view of Swain as applied to Claim 1, and further in view of Akaishi (WO2004/046062). Please see the corresponding US version (2006/0115408).

Meng and Swain teaches a method of making diamond particles using carbon and boron doping using high temperature and high pressure conditions but neither of them teach a specific pressure of 80-110 GPa.

Akaishi teaches a high hardness diamond having a maximum size of 100nm or less (abstract). The diamond is conductive and therefore has a low resistivity (para. 0051). Regarding the hardness, Akaishi teaches that the hardness is over 80 GPa (para. 0048, 100 GPa) and over 110 GPa (para. 0050, 115 GPa).

It would have been obvious to one of ordinary skill in the art at the time of the invention to provide the superhard diamond with a hardness of over 80 and 110 GPa, as taught by Akaishi, for use in tools, such as drills because these tools require a high strength and resistance under a lot of pressure, in the invention described by Meng and Swain.

Claims 1, 2, 3 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wentorf (3148161) and further in view of Swain.

Wentorf teaches formation of a boron doped diamond (col. 2, lines 32-34). The diamond growth process is made by subjecting a carbonaceous product and a catalyst to high temperature and high pressure (col. 2, lines 42-44). The boron enters the diamond crystal lattice (col. 4, lines 70-75).

Swain teaches a boron-doped nanocrystalline diamond (title, abstract). The diamond particles are disclosed to be between 10-16nm in size (para. 43) or 20nm (para. 0031) and the boron concentration is between 1 to 20ppm (para. 0034 and 0071). The elemental boron is in the crystal as a dopant (para. 0011, 0012). This boron is incorporated within the lattice of diamond lattice (para. 0071). The diamond nanocrystals are highly conductive (para. 0031(i)). Although Swain does not specifically teach that the average particle size is below 50nm, however, it is inherent that since the particle range is all below 50nm, that the average particle size would be below 50nm.

It would have been obvious to one of ordinary skill in the art at the time of the invention that the size of the diamond particles could be optimized based on the desired

use, accuracy of the diamond and the size of the device it would be used with. Furthermore, it would be obvious to one of ordinary skill in the art at the time of the invention that the selection of a specific size range is viewed to be the optimization of a known process, which could have been determined through routine experimentation, and is held to be obvious by *In re Boesch,* 205 USPQ 215.

As to the boron amount, since boron can be used to enhance the mechanical strength and oxidative resistance of a diamond particle, it would have been obvious to one of ordinary skill in the art at the time of the invention that the amount used could be optimized based on the desired strength and oxidative resistance of the diamond particle.

Regarding Claim 2, Swain teaches an electrical resistance of 0.2 ohm cm (para. 0031). This is less than 10 ohm cm.

Regarding Claim 3, since Swain teaches a particle range of between 10-16nm (para. 0034), the maximum particle range is less than 50nm and the average particle diameter is less than 30nm.

Claims 4 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wentorf and further in view of Swain (2005/0110024) as applied to Claim 1, and further in view of Akaishi (WO2004/046062). Please see the corresponding US version (2006/0115408).

Wentorf and Swain teaches a method of making diamond particles using carbon and boron doping using high temperature and high pressure conditions but neither of them teach a specific pressure of 80-110 GPa.

Akaishi teaches a high hardness diamond having a maximum size of 100nm or less (abstract). The diamond is conductive and therefore has a low resistivity (para. 0051). Regarding the hardness, Akaishi teaches that the hardness is over 80 GPa (para. 0048, 100 GPa) and over 110 GPa (para. 0050, 115 GPa).

It would have been obvious to one of ordinary skill in the art at the time of the invention to provide the superhard diamond with a hardness of over 80 and 110 GPa, as taught by Akaishi, for use in tools, such as drills because these tools require a high strength and resistance under a lot of pressure in the invention described by Wentorf and Swain.

Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Meng.

Meng teaches a method for synthesizing boron doped diamond for improving the oxidation resistance of said diamond crystals includes forming a fully dense core (mixture) of graphite, catalyst/solvent metals, optional diamond seed crystals, and a source of boron (abstract). This mixture is subjected to diamond-formed high pressure/high temperature (HP/HT) conditions for a time adequate for forming diamond. The temperature an be up to 850 degrees (para. 0025) and is known to be heated up to 1500 to 2000 degrees C (para. 0004). The thus-formed diamond product is recovered to contain boron substituted into the diamond structure (abstract). The

fully dense core is substantially devoid of nitrogen (N) content, which mostly comes from air (abstract). Thus, the fully dense core is substantially devoid of air. The preferred source of B is amorphous B; although other sources of B can be used to form the boron-doped, blue diamond of the present invention (abstract).

Meng describes this method for producing boron doped diamond that includes forming a fully dense core (mixture) of graphite, catalyst/solvent sintering aid, an optional diamond seed crystals, and a source of boron (para. 0009). This mixture is subjected to diamond-formed high pressure/high temperature (HP/HT) conditions for a time adequate for forming diamond (para. 0009). The thus-formed diamond product is recovered to contain boron substituted into the diamond structure. The fully dense core is substantially devoid of nitrogen (N) content, which mostly comes from air. Thus, the fully dense core is substantially devoid of air (para. 0009). The preferred source of 13 is amorphous B; although other sources of B can be used to form the boron-doped, blue diamond of the present invention (para. 0009).

The boron itself is substituted into the diamond structure (para. 0009 and 0014). The amount of boron used can be between 0.001 to 0.6% (para. 0016).

As to the size, Meng teaches that the size of the diamond particle can be about 50 micrometers (para. 0016), But does not necessarily explains that the average particle size is 5,000nm or that the maximum size of the particles is 10,000nm.

Since the particle range includes 5,000nm, it would have been obvious to one of ordinary skill in the art at the time of the invention that the size of the diamond particles

could be optimized based on the desired use, accuracy of the diamond and the size of the device it would be used with.

Claims 13-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Meng as applied to claim 12 above, and further in view of Swain and further in view of Akaishi and further in view of Bernard ("Non Destructive determination of the boron concentration of heavily doped metallic diamond thin films from Raman Spectroscopy").

Meng teaches a method of making diamond particles using carbon and boron doping using high temperature and high pressure conditions but neither of them teach a specific pressure of 80-110 GPa, but does not necessarily teach a conductivity of less than 1 ohm.

Akaishi teaches a high hardness diamond having a maximum size of 100nm or less (abstract). The diamond is conductive and therefore has a low resistivity (para. 0051). Regarding the hardness, Akaishi teaches that the hardness is over 80 GPa (para. 0048, 100 GPa) and over 110 GPa (para. 0050, 115 GPa).

It would have been obvious to one of ordinary skill in the art at the time of the invention to provide a harder pressure in the formation of the diamond, as taught by Akaishi in the process for making diamond, in the process described by Meng because greater pressure speeds up the rate of formation. Furthermore, it would have been obvious to one of ordinary skill in the art at the time of the invention to provide the superhard diamond with a hardness of over 80 and 110 GPa, as taught by Akaishi, for

use in tools, such as drills because these tools require a high strength and resistance under a lot of pressure.

As to the diamond conductivity, Swain teaches a boron-doped nanocrystalline diamond (title, abstract). The diamond particles are disclosed to be between 10-16nm in size (para. 43) or 20nm (para. 0031) and the boron concentration is between 1 to 20ppm (para. 0034 and 0071). The elemental boron is in the crystal as a dopant (para. 0011, 0012). This boron is incorporated within the lattice of diamond lattice (para. 0071). The diamond nanocrystals are highly conductive (para. 0031(i)). Swain teaches an electrical resistance of 0.2 ohm cm (para. 0031). This is less than 10 ohm cm.

Bernard explains that two factors affect the conductivity of a diamond (conductivity is inverse to resistance). The first being the barrier thickness between a conductive metal and the diamond (page 282, col. 1) and the concentration of dopants (page 282, col. 1). Bernard explains that between 2000 to 14000 ppm of boron is used in the diamond (page 283, col. 1).

Since diamond has a naturally high conductivity and boron doping affects its conductivity, it would have been obvious to one of ordinary skill in the art at the time of the invention to optimize the amount of boron in the diamond making process, as taught by Bernard, in the diamond compound of Meng, Akaishi and Swain based on the desired resistance/conductivity levels in the device/product that uses the diamond.

Regarding Claim 14, Swain teaches a boron-doped nanocrystalline diamond (title, abstract). The diamond particles are disclosed to be between 10-16nm in size

(para. 43) or 20nm (para. 0031) and the boron concentration is between 1 to 20ppm (para. 0034 and 0071). The elemental boron is in the crystal as a dopant (para. 0011, 0012). This boron is incorporated within the lattice of diamond lattice (para. 0071). The diamond nanocrystals are highly conductive (para. 0031(i)). Although Swain does not specifically teach that the average particle size is below 500nm, however, it would have been obvious to one of ordinary skill in the art at the time of the invention that the size of the diamond particles could be optimized based on the desired use, accuracy of the diamond and the size of the device it would be used with.

Regarding Claims 15 and 16, Akaishi teaches that the hardness is over 80 GPa (para. 0048, 100 GPa) and over 110 GPa (para. 0050, 115 GPa).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to SHENG HAN whose telephone number is (571)270-5823. The examiner can normally be reached on Monday-Thursday, 8:00-5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Melvin Curtis Mayes can be reached on 571-272-1234. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Sheng Han
Examiner
Art Unit 1793

July 11, 2010

/Melvin Curtis Mayes/
Supervisory Patent Examiner, Art Unit 1793